SE 101 Introduction to Methods of Software Engineering
Quiz #2

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Novemer 27, 2003   **Student ID:**_____
10:30 a.m.   **Student Block Number:**_____
45 min.

This quiz is closed book, closed notes. No calculators are allowed. The quiz is double-sided. There are five (5) questions, worth a total of 58 marks. Show your work to receive partial credit for incorrect answers.

1. (12 marks) Professional Engineering
a) Give two examples of safety-critical application domains that might fall under the Professional Engineers Act, and explain briefly why each domain could be safety-critical. (An *application domain* is a category of software systems that have similar users and that solve similar problems. For example, "video games" is an application domain, whereas "Doom" is a particular application in that domain.)

- o Medical devices, medical monitors
- o Software that controls transportation systems (trains, planes, cars)
- o Software that controls plants (chemical reactions, electrical transmissions)
- o Software that controls moving structures (draw bridges)
- o Defense systems (border or airspace monitors, weapons systems)

b) Would a professional engineer necessarily lose his or her license if a product that he or she has signed off on subsequently fails and causes damage or harm? Defend your answer in 1-2 sentences.

No. Only if the engineer is found to have been negligent (i.e., failed to use standard practices) would the engineer be at risk of losing his or her license.

c) Explain one way in which the Code of Ethics can help the practising engineer.

- o Provides a defense against requests to act unethically
- o Inspires public confidence in profession and, by association, the professional
- o Stimulates ethical behaviour, which can enhance the engineer's reputation

2. (6 marks) Safety
A ground-based air-traffic-control system monitors the location, direction, and speed of all aircraft within a certain radius of the ground base. All of the aircraft within a particular sector of that radius are displayed on the console of one human air-traffic controller, who is responsible for issuing orders to the pilots of the displayed aircraft, to ensure that the planes maintain a minimum separation from each other. The system will sound an alarm whenever two planes violate this minimum separation.

a) Give an example of a possible hazard of this system.

b) Give two examples of generic software errors that could possibly lead to a hazard in this system (the errors needn't lead to the hazard that you listed in 2a).
o Software doesn't sample input data often enough
o Mismatch between software-component interfaces
o Race condition among concurrent components that read and write the same data
o Malfunctioning input sensors
o Radiation that flips the values of bits, modifying data values or program statements

3. (6 marks) Intellectual Property
a) Name three mechanisms, as described in the IPE text, for protecting intellectual property
b) For each of the mechanisms that you named in your answer to question 3a, give an example of intellectual property from the following product description that could be protected by that mechanism.

Pliable Rugs is a new product that automatically manufactures custom-sized rugs. A complex software system takes as input a rug design and a rug size, and the software outputs a modified rug design that is generated by uniformly stretching the original design to the requested size. For example, the rug on the right is the result of taking a design for a 5'x9' rug, shown on the left, and stretching the design to make a 9'x9' rug.
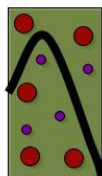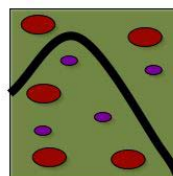
5'x9' rug   9'x9' rug

The output of the software system is in a confidential format that can be easily displayed on a computer console, thereby displaying the modified design to the user, so that the customer can decide whether the stretched design is acceptable. The output can also be fed to a programmable loom to manufacture a rug that conforms to the modified design. Pliable Rugs has a database of over 100 proprietary rug designs to choose from, and can be used to manufacture rugs that range from 3'x3' to 15'x20'.

Patent – the whole system that automatically manufactures custom-sized rugs
       – the software algorithm for generating the modified design
Copyright – the software program for generating the modified design
Trademark – the product name "Pliable Rugs"
Industrial Design – the original rug designs in the product's database
Integrated Circuit Topography – the special-purpose computer the instructs the loom
Trade Secret – format of software's output

4. (4 marks) Software Quality Attributes
For both the air-traffic-control system, described in question 2, and the Pliable Rugs product, described in question 3, list a quality attribute that users or safety regulators would want the software to exhibit (select different attributes for the two systems). For each quality attribute, provide an example of a *measurable* requirement (*i.e.,* a specification of the attribute that could be used to determine, possibly after the system is operational, whether the software exhibits the attribute).

Air-traffic-control system
>   Availability – system is operational 99.999% of the time
>   Reliability – system displays correct data 99.999% of the time
>   Usability – 90% of human traffic controllers can look at new screen of data and assess the situation within 30 seconds.
>   Load (performance) – system can accurately monitor and display the data for 20 aircraft at any time

Pliable Rugs
>   Performance – computes and displays modified rug design within 30 seconds
>   Usability – 90% of focus group of sales representatives approve of the user interface; key person approves of user interface
>   Learnability – 90% of sales representatives can, within one week of using the system, correctly select and enter desired input with 15 seconds.
>   Economical – pliable rug costs no more than $50 per sq. ft., over and above the cost of a 5'x9' rug of the same the design

5. (30 marks) Grammar
Below is a passage of text that contains multiple grammatical, word-choice, and word-placement errors. Identify and correct 15 instances of such errors by marking up the text.

The Center for Science in the Public Interest, ~~that~~ which is a U.S. nutrition advocacy group, reports an increase in food-borne illnesses (e.g., E. coli, salmonella) ~~which~~ that are ~~affected~~ effected by contaminated produce. Although ~~less~~ fewer cases of food-borne illness are due to contaminated produce than to contaminated meat (e.g., beef, poultry, seafood, eggs), the gap between the numbers of cases attributed to each source is rapidly ~~declining~~shrinking. The causes of produce contamination are not so different ~~than~~ from the causes of meat contamination: in both cases, contamination is effected by improper storage of foods and by infected ~~workmen~~ workers ~~that~~ who handle the foods.

You might be inclined to ~~deduce~~ infer from this report that produce is no healthier than other food types ~~from this report~~. However, scientists continue to ~~ensure~~ assure the public that the produce that is available in this country is generally safe to eat; and

nutritionists continue to recommend a diet ~~comprised of~~comprising fruits and vegetables, whole grains, and a small amount of dairy. You can help to ~~insure~~ ensure that the produce that you prepare is safe to eat by washing fruits and vegetables thoroughly under running water, by peeling produce, and by removing the outer leaves of leafy vegetables. You ~~also~~ might also consider choosing domestically grown produce over imported produce, so that you reduce the risk of being contaminated by the water used to rinse, ice, or wash the produce. If your immune system is compromised, you should ~~only~~ eat only cooked produce.

BONUS question (7 marks) Error propagation
You are working at your computer during a thunderstorm, and you start to wonder just how far away the lightning strikes are (because you wonder whether you should unplug your computer). You time the interval between the next lightning flash and its accompanying thunder to be $1 \text{ s} \pm 0.3 \text{ s}$. The speed of sound is 331 m/s. Assume that light travels instantaneously, and that the time that you see the lightning flash is the exact time that the lightning strikes.

a) What is the nominal distance of this lightning strike from you?
   331 m

b) What is the minimal distance of this lightning strike from you?
   232 m,   200 m

c) Using linear approximation, what is the approximate worst-case uncertainty in your calculation of the nominal distance?
   99m,   100m